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PRODUCT DIFFERENTIATION AND THE EQUILIBRIUM STRUCTURE OF THE MANUFACTURER-RETAILER RELATIONSHIP

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Inter- and Intrabrand Competition and the Equilibrium Structure of the Manufacturer-Retailer Relationship*

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Abstract

This paper analyses the equilibrium choice of vertical arrangement chosen by manufacturers in a three-stage Bertrand -Game with product differentiation. We focus on two types of vertical arrangements namely exclusive dealing and exclusive territory. Exclusive dealing is used to restrict inter-brand competition, while exclusive territory is used to restrict intra-brand competition. In the first stage, we endogenize the manufacturers' decision to have a particular form of vertical arrangement. In the second stage manufacturers set the wholesale price, and in the third stage retailers set the retail price. We assume that manufacturers face a competitive supply of retailers. The results show that the equilibrium of vertical arrangement depends on the degree of product differentiation. When products are sufficiently differentiated, manufacturers prefer to sell the products to a large number of competitive retailers. When products are highly homogeneous, exclusive territory with exclusive dealing might be adopted by manufacturers.

JEL Classification:D43, L22, L42

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1 Introduction

Vertical restraints are special form of vertical arrangements between manufacturers and retailers which include restrictions on competition. The welfare effect of these arrangements is frequently discussed in the literature. There are conflicting arguments on the desirability of vertical restraints (see Carlton and Perloff, 1994, Waterson, 1993, and Tirole, 1988). Some studies argue that vertical restraints are acceptable, since these arrangements will prevail only if there are efficiency gains. Others argue the opposite by stating that vertical restraints will foreclose entry, and are thus detrimental to the consumers.

The above ambiguity implies that an outright ban on vertical restraints might not be efficient. This insight is reflected in the American antitrust law where vertical restraints are considered under the rule of reason.[1] Thus, we require a balancing of the positive and negative effects on a case by case basis. Furthermore, an outright ban on vertical restraints might encourage substitution, not only between vertical restraints and vertical integration, but also among vertical restraints, because the same objective can often be obtained by various types of vertical restraints (Kay, 1990, Mathewson and Winter, 1985).

Vertical restraints can take several forms, such as; resale price maintenance, quantity fixing, tie-in, exclusive territory and exclusive dealing. The present paper will focus on the last two types of restraints, i.e. exclusive territory and exclusive dealing. Exclusive territory is the right given to a retailer by a manufacturer which allows the retailer to act as a sole distributor in a specific territory. By doing this the manufacturer is able to reduce intra-brand competition at the retailer level.

Exclusive dealing is the right given to a retailer by a manufacturer to sell exclusively the product of the manufacturer. It is used to restrict inter-brand competition. The desirability of this arrangement is still often debated. The traditional objection against exclusive dealing is that it creates a barrier to entry at the manufacturer level, since existing retailers exclusively sell the products of the incumbent firms. A producer that wants to enter the market cannot use the existing retailers to distribute its product. The producer must either enter at two stages as a vertically integrated firm, both at the producer and retailer level, or set up its own retailernet, which might be costly. On the contrary, the proponents of exclusive dealing argue that an

[1] Continental T.V., Inc. vs. GTE Sylvania Inc., 433 U.S. 36 (1977). Only resale price maintenance is illegal per se.

exclusive dealership allows retailers to concentrate their efforts on a particular brand. In addition, when retailers sell only one make, manufacturers can avoid an externality problem. This externality problem exists if for instance, a manufacturer invests in brand enhancing activities like services and training. If its dealer also carries other brands (non exclusive dealing), then other manufacturers may also benefit from these investments.[2]

In the literature, exclusive territory and exclusive dealing are usually analysed separately. Rey and Stiglitz (1995) focus their analysis on the exclusive territory and do not touch upon exclusive dealing arrangements. They show that in equilibrium manufacturers have an incentive to grant exclusive territory to retailers in order to reduce competition at the lower level. The exclusive territory will eliminate intra-brand competition at the retailer level, hence the retail price and the wholesale price will be higher under this arrangement. In the absence of this arrangement, pure intra-brand competition will push the retailer to charge a zero mark-up.

Lin (1990) endogenizes the manufacturers' decision to adopt exclusive dealing or non exclusive dealing. However, he exogeneously assumes that there is no intra-brand competition, which is essentially equivalent to assuming that manufacturers impose exclusive territory restriction. He shows that given absence of downstream intra-brand competition, imperfectly competitive upstream manufacturers will always choose exclusive dealing because it dampens competition among them. Lin's claims further without stating formal proofs that if there is potentially an intra-brand competition at the retailer level, manufacturers will impose exclusive dealing and exclusive territory.

In practice exclusive territory and exclusive dealing quite often come together, for instance in the belgian automobile market (Mycielski, Riyanto, and Wuyts, 1994). Many belgian exclusive car retailers accept to carry the products of only one manufacturer because in return they get an exclusive territory. Thus they are the only one selling the brand within a certain area. As a consequence, if we consider exclusive territory and exclusive dealing separately, we might loss some useful information. It will be interesting if we could have a theoretical framework which takes into account those two arrangements. The present paper intends to provide such an analysis. More precisely, this paper endogenizes the manufacturers' decision on whether or not to assign an exclusive territory right, an exclusive dealership or combination of both. We then analyse the welfare effect of all these different vertical

[2] See Marvel(1982) and Besanko and Perry (1993) for papers on the externality problem. Besanko and Perry (1993) show that the equilibrium incentives for exclusive dealing will also depend on the severeness of the externality problem.

arrangements. A good understanding of this issue will enable us to draw antitrust policy implications.

To proceed we construct a three-stage Bertrand-Game with product differentiation. Initially, we assume that a duopoly market structure exists at the manufacturer level. There are three stages in the game, in the first stage manufacturers decide the preferred type of arrangements. In the second stage manufacturers set the wholesale price, and in the third stage retailers set the retail price. We abstract from the informational problem faced by manufacturers.[3]

The model employed here is based on Lin (1990). There is a major difference in the set-up of the model between Lin's and this paper. In Lin's model there are two alternative arrangements that can be chosen, i.e. exclusive dealing (ED) and non exclusive dealing (NED). Lin assumes that manufacturers take as given whether or not there is intra-brand competition in the market. In contrast, we assume that the existence of intra-brand competition is endogenously determined by manufacturers. Thus for instance, if manufacturers prefer not to have intra-brand competition, they can assign exclusive territory right to retailers. To capture this, we allow firms to choose among: exclusive territory with exclusive dealing (ET;ED), exclusive territory with non exclusive dealing (ET;NED), non exclusive territory with exclusive dealing (NET;ED), and non exclusive territory with non exclusive dealing (NET;NED).

We derive an important implication, namely that policy makers need to be careful in deciding whether a particular form of vertical arrangements is harmful for welfare. Our analysis indicates that when manufacturers could choose among combinations of these arrangements, i.e. exclusive territory, non exclusive territory, exclusive dealing, and non exclusive dealing, and when we take into account different degrees of product differentiation, the equilibrium arrangement depends on the degree of product differentiation. When products are sufficiently differentiated, a manufacturer prefers to sell the brands to a large number of retailers, thus creating intra-brand competition. Intuitively, this is plausible. A high degree of product differentiation implies that products are imperfect substitutes (the cross price effect is weak), hence it is good for manufacturers to have intra-brand competition. The intra-brand competition will put retailers in direct competition, which then will force retailers to charge zero mark-up. Manufacturers are then able to extract all the profits from retailers. As products are almost homoge-

[3]See Bernheim & Whinston (1985), and Martimort (1996) for the strand of literature which uses agency framework to analyse the informational problem.

neous, exclusive territory with exclusive dealing becomes the unique subgame perfect equilibrium. Thus, manufacturers prefer to restrict intra-brand and inter-brand competition to obtain higher profits.

The rest of the paper is organised as follows. Section 2 presents the model. Section 3 covers the solution to the model. In section 4, we derive some policy and empirical implications of the paper. Section 5 concludes. Some proofs and calculations are relegated to the appendix.

2 The Model

We consider a vertical structure which has a duopoly setting at the manufacturer level. Each manufacturer produces a single product. In addition, they face a competitive supply of potential retailers. Thus, the number of retailers in the market adjusts to the need of manufacturers.[4] Manufacturers, retailers, and consumers reside within a single geographic region. For simplicity, production costs and retailing costs are assumed to be equal to zero. We assume that there are no fixed costs. Firms compete in price. Each firms face a linear demand function in the following form:

$$\begin{aligned} x_1 &= 1 - p_1 + ap_2 \\ x_2 &= 1 - p_2 + ap_1 \end{aligned} \qquad (1)$$

Assume $0 < a < 1$. A positive influence of the price of the competitor's brand on the demand of one's brand (products are substitutes) implies that $a > 0$. To have overall demand diminishing with a higher average price it is necessary that $a < 1$. As $a \to 0$, the change in the price of the competitor's brand only has a small effect on the demand of one's brand. Hence, this implies that brands are highly differentiated. Thus, $a \to 1$ implies that brands are almost homogeneous.

We use a three-stage game in the analysis (see figure 1), and assume perfect and complete information. In the first stage the two manufacturers choose the preferred type of vertical arrangements among combinations of these alternatives; exclusive territory (ET), non exclusive territory (NET), exclusive dealing (ED), and non exclusive dealing (NED). Thus, for instance both manufacturers may decide to adopt NET rather than ET. This decision will bring intra-brand competition at the retailer level. At the same time, if

[4] To influence the number of retailers in the market, a manufacturer may either appoint directly which retailers are allowed to carry its brand, or indirectly through its pricing policy and other form of restraints (Katz, 1991).

both of them do not restrict retailers to carry only their brands, then NED prevails. Alternatively, if they require retailers to cary only their brands, then ED prevails.

If both manufacturers opt to ET, they can decide whether or not to assign exclusive dealership to retailers. Thus, we could have (ET;ED) or (ET;NED). In addition, we allow for a possibility of getting mixed cases, in which one manufacturer prefers to have NET, thus sells his product through several retailers, while another one prefers to have ET, thus sells his product through one retailer. The fact that there are not more than two brands reduces the number of possible outcomes, because the decision of one manufacturer to use ED forces another one to do the same.

To sum-up, there will be six different cases (see also figure 1), namely :

1. (ET;NED) : Both manufacturers only adopt exclusive territory and not exclusive dealing. Hence, there will be one retailer which carries two brands.

2. (ET;ED) : Both manufacturers adopt exclusive territory and exclusive dealing. There are two retailers and each of them sells only one brand.

3. (NET;NED) : Neither manufacturers adopt exclusive territory nor exclusive dealing. The number of retailers is unlimited, each of them carries two brands.

4. (NET;ED) : Both manufacturers adopt exclusive dealing but not exclusive territory. The number of retailers is unlimited, each of them sells one brand

5. (Mix;ED) : One manufacturer uses a single retailer, the second one uses a competitive network of retailers, and exclusive dealing prevails.

6. (Mix;NED) : One manufacturer uses a single retailer, the second one uses a competitive network of retailers. Both manufacturers do not assign exclusive dealership to retailers.

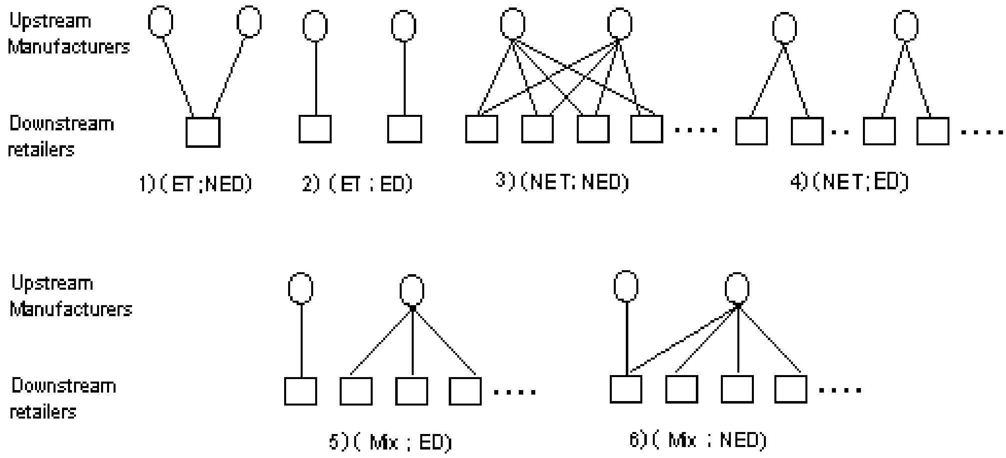


Figure 1: Vertical Arrangements

Under (ET;ED) there will be a duopoly at the retailer level, since each retailer carries a specific brand of a manufacturer. In the (ET;NED) case there is a monopolist retailer.

In the NET cases, competition at the retailer level is assumed to be perfect, thus in the presence of NET, retailers are forced to charge zero mark-up. Therefore the retail price will be equal to the wholesale price plus retailing costs. The retailing cost is zero by assumption. Analytically the ED case and the NED case under NET are the same, because choosing NET gives as a consequence that products will be distributed by many retailers. However, if we introduce a market imperfection, like for instance an externality problem, then the ED case differs from the NED case. We abstract from the informational and externality problems. Under NET, it is good for manufacturers to allow more intra-brand competition at the retailer level to squeeze the monopoly power of retailers. By doing this, a successive mark-up problem can be avoided. The retail price will be driven down to marginal cost, and thus it will be just equal to the wholesale price. This enables us to only concentrate on the manufacturers' problem.

There are two possible mixed cases (figure 1.5. and figure 1.6.). In figure 1.5. one manufacturer prefers to use an exclusive single retailer to serve the market, while the second one prefers to have intra-brand competition, thus distributing its product through many retailers. Both manufacturers assign exclusive dealership to retailers. Figure 1.6. illustrates the case where one manufacturer avoids intra-brand competition by assigning exclusive territory right to a retailer and the second manufacturer allows intra-brand competition. Both manufacturers do not assign exclusive dealership to retailers.

After deciding a particular vertical arrangement to adopt, in the second stage manufacturers set the wholesale price, and in the third stage retailers set the retail price. We solve the model starting from the third stage and move backwardly. We concentrate on the pure-strategy subgame perfect Nash-Equilibrium and we assume complete information. At the retailer (manufacturer) level, retailers (manufacturers) move simultaneously.

3 Solution of the Model

In what follows, we calculate the optimal profits for manufacturers, the equilibrium wholesale and retail prices, and the total welfare for all possible cases. Then, we compare the manufacturers' profit and the total welfare in all different cases. Let us start with the ET case.

3.1 Exclusive Territory with Exclusive Dealing

We proceed by solving the retailers' problem. The two retailers are assumed to treat wholesale prices as given. Retailers maximise profits with respect to retail prices:

$$\max_{p_1} \pi_1 = (1 - p_1 + ap_2)(p_1 - w_1^*) \tag{2}$$

$$\max_{p_2} \pi_2 = (1 - p_2 + ap_1)(p_2 - w_2^*) \tag{3}$$

Where $p_i, \quad i \in \{1, 2\}$ indicates retail prices and w_i^* indicates optimal wholesale prices. We derive the optimal best response retail prices ($p_1^*$and p_2^*) by taking the first order conditions and then solving for the optimal retail prices simultaneously.

$$p_1^* = p_2^* = \frac{2w_1^* + aw_2^* + 2 + a}{(2 - a)(2 + a)} \tag{4}$$

In the second stage manufacturers maximise the wholesale profits with respect to the wholesale prices by taking into account retailers' best response functions.

$$\max_{w_1} \Pi_1 = [1 - p_1^*(w_1^*) + ap_2^*(w_2^*)]\, w_1 \tag{5}$$

$$\max_{w_2} \Pi_2 = [1 - p_2^*(w_2^*) + ap_1^*(w_1^*)]\, w_2 \tag{6}$$

Taking the first order condition with respect to wholesale prices and then simultaneously solving for the optimal wholesale prices ($w_1^*$and w_2^*), we obtain:

$$w_1^* = w_2^* = \frac{a+2}{4-a(a+2)} \tag{7}$$

The solutions for the optimal retail prices and manufacturers profits are as follows:

$$p_1^* = 2\frac{3-a^2}{(2-a)(4-2a^2-a)} \tag{8}$$

$$\Pi_1^* = (a+2)\frac{2-a^2}{(2-a)(2a^2+a-4)^2} \tag{9}$$

By symmetry we obtain $p_1^* = p_2^*$ and $\Pi_1^* = \Pi_2^*$.

The total surplus under this arrangement is simply the summation of the consumer surplus, profits of retailers, and profits of manufacturers, and can be expressed as:

$$TS_{(ET;ED)} = \left(\frac{1}{1-a} - p\right)(1-p+ap) + 2\Pi + 2\pi \tag{3.9}$$

$$TS_{(ET;ED)} = \left(2-a^2\right)\frac{14-5a^2+4a^3-12a}{(1-a)(a-2)^2(2a^2+a-4)^2} \tag{10}$$

3.2 Exclusive Territory with Non Exclusive Dealing

The maximisation problem for the single common retailer can be expressed as follows:

$$\max_{p_1,p_2} \pi_1 = (1-p_1+ap_2)(p_1-w_1^*) + (1-p_2+ap_1)(p_2-w_2^*) \tag{11}$$

We obtain the following retailers' best response function :

$$p_1^* = p_2^* = \frac{1}{2}\left(w_1^* - \frac{1}{(a-1)}\right) \tag{12}$$

Solving the maximisation problem of the two manufacturers for the optimal wholesale prices results in (by symmetry $w_1^* = w_2^*$) :

$$\max_{w_1} \Pi_1 = [1-p_1^*(w_1^*) + ap_2^*(w_2^*)]\,w_1 \tag{13}$$

$$\max_{w_2} \Pi_2 = [1 - p_2^*(w_2^*) + a p_1^*(w_1^*)]\, w_2 \tag{14}$$

$$w_1^* = w_2^* = \frac{1}{2-a} \tag{15}$$

Hence, the optimal retail prices and manufacturers' profits are:

$$p_1^* = p_2^* = \frac{1}{2}\frac{3-2a}{(a-2)(a-1)} \tag{16}$$

$$\Pi_1^* = \Pi_2^* = \frac{1}{2(a-2)^2} \tag{17}$$

The total surplus under this arrangement is calculated as follows;

$$TS_{(ET;NED)} = \frac{4a-7}{4(a-1)(a-2)^2} \tag{18}$$

If we compare the above two cases (see proof of lemma 1 in the appendix) we find that the equilibrium wholesale prices, wholesale profits, and total welfare under exclusive dealing are higher than under non exclusive dealing. However, retail prices are lower under exclusive dealing than under non exclusive dealing.

Thus, suppose manufacturers unilaterally increase the wholesale prices, then to maximise profits retailers will also increase the retail prices. In the maximisation process, a NED retailer takes into account two factors. Firstly, the retailer realizes that the demand for the product of interest decreases after the price increases, but demand for the second brand increases because it is an imperfect substitute. The two effects have opposite signs. An ED retailer takes into account only the first effect because it sells only one brand. Therefore wholesale price elasticity of retailer demand is greater under NED than ED. Manufacturers, thus, have less monopoly power under NED.

Normally, a higher price elasticity of demand lowers monopoly profits and reduces social welfare losses. But in this model there are two subsequent markets characterized by duopolistic competition. In NED case the price elasticity of demand for the products of the upstream duopolist is higher. The price elasticity of demand for the final consumers is the same in both cases. The main effect of a change from ED to NED is that monopoly power and profits are transferred from manufacturers to retailers. Therefore, in the absence of intra-brand competition manufacturers prefer to choose ED, because it dampens competition among manufacturers. Note that under ED there is more competition at the retailer level (two sellers) than under NED (single seller), thus it is quite reasonable that in our case retail prices under ED are lower than retail prices under NED. Hence, the consumers also take advantage of this situation.

3.3 Non Exclusive Territory Cases

Both cases under NET, e.g. NED case and ED case (figure 1.3. and figure 1.4.) are analytically equivalent because choosing NET means that products are distributed by many retailers. Retailers are then forced to charge a zero mark-up.

Manufacturers maximise the following wholesale profits:

$$\max_{w_1} \Pi_1 = \left[1 - p_1^*(w_1^*) + ap_2^*(w_2^*)\right] w_1 \tag{19}$$

$$\max_{w_2} \Pi_2 = \left[1 - p_2^*(w_2^*) + ap_1^*(w_1^*)\right] w_2 \tag{20}$$

Note that $p_i^* = w_i^*$. The solution to the maximisation problems are:

$$p_i^* = w_i^* = \frac{1}{2-a} \tag{21}$$

Hence, the optimal manufacturers' profits are:

$$\Pi_1^* = \Pi_2^* = \frac{1}{(a-2)^2} \tag{22}$$

The total surplus under this arrangement is:

$$TS_{NET} = \frac{2a-3}{(a-1)(a-2)^2} \tag{23}$$

Since the retailer level is perfectly competitive, manufacturers can thus eliminate the double mark-up problem. Hence, we have a situation which resembles vertical integration.

3.4 Mixed Cases

3.4.1 Mixed Case with Exclusive Dealing

From our earlier discussion we know that this case prevails when one manufacturer prefers to have ET, thus uses a single retailer only (we will index it by '1'). While the second one prefers to have NET, thus distributes its product through a large number of retailers (we will index it by $i-1$, for $i \in \{1, 2, 3, 4, ..., n\}$). Each retailers carries only one specific brand. Thus, the brand with ET is sold to retailers at a monopolistic price and the brand with NET at cost price. This results in an asymmetric equilibrium.

For the brand with both exclusive territory and exclusive dealing, the retail price can be derived from the following maximisation problem:

$$\max_{p_1} \pi_1 = (1 - p_1 + ap_2)(p_1 - w_1^*) \tag{24}$$

This yields the following optimal retail price:

$$p_1^* = \frac{1}{2}w_1^* + \frac{1}{2} + \frac{1}{2}ap_2^* \tag{25}$$

Since the retailer who distributes the brand of the second manufacturer in the NET setting sells the brand to consumers at a cost price, the retailer's profit will be zero.

$$p_{i-1}^* = w_2^*; \quad \pi_{i-1} = 0 \tag{26}$$

Therefore, the optimal retail price for the first retailer will be:

$$p_1^* = \frac{1}{2}w_1^* + \frac{1}{2} + \frac{1}{2}aw_2^* \tag{27}$$

The first manufacturer maximises this profit function:

$$\max_{w_1} \Pi_1 = [1 - p_1^*(w_1^*) + ap_2^*(w_2^*)]\, w_1 \tag{28}$$

Substituting equation (26) and (27) into equation (28), we obtain:

$$\max_{w_1} \Pi_1 = \frac{1}{2}(1 - w_1 + aw_2)\, w_1 \tag{29}$$

The second manufacturer solves the following maximisation problem:

$$\max_{w_2} \Pi_2 = [1 - p_2^*(w_2^*) + ap_1^*(w_1^*)]\, w_2 \tag{30}$$

Solving the first order conditions of the above problems, we obtain the following best response wholesale prices for manufacturers:

$$w_1^* = \frac{1}{2} + \frac{1}{2}aw_2^* \tag{31}$$

$$w_2^* = \frac{2 + aw_1^* + a}{4 - 2a^2} \tag{32}$$

The optimal wholesale prices for manufacturers are thus:

$$w_2^* = \frac{3a - 4}{5a^2 - 8} \tag{33}$$

$$w_1^* = \frac{(a-2)a - 4}{5a^2 - 8} \tag{34}$$

The optimal retail prices are:

$$p_1^* = \frac{3}{2}\left(\frac{a^2 - 2a - 4}{5a^2 - 8}\right) \tag{35}$$

$$p_{i-1}^* = w_2^* \tag{36}$$

Hence, the optimal wholesale profits are:

$$\Pi_1^* = \frac{1}{2}\frac{(a^2 - 2a - 4)^2}{(5a^2 - 8)^2} \tag{37}$$

$$\Pi_2^* = \frac{(2a^2 + 48a + 32 - 24a^3 - 9a^4)}{(5a^2 - 8)^2} \tag{38}$$

The total surplus under this arrangement is:

$$TS_{(Mix;ED)} = \frac{124a^3 + 300a^2 - 85a^4 - 33a^5 - 240 - 96a}{8(a-1)(5a^2 - 8)^2} \tag{39}$$

3.4.2 Mixed Case with Non Exclusive Dealing

The only difference between this case and the previous one is that in this case NED prevails. Thus, a retailer might also carry a second brand (see figure 1.6). However, one brand is sold at the cost price because of the intra-brand competition. H**ence this mixed case gives, essentially, the same analytical results as the previous mixed case**. From here onward, with abuse of notations, we use $\Pi_{mix,ET}$ to indicate the profit of a firm chooses to impose exclusive territory in a mixed case, and, $\Pi_{mix,NET}$ to indicate the profit of a firm chooses non exclusive territory in a mixed case.

3.5 Comparison of the Results

From the comparison of the wholesale profits under different vertical arrangements, we have the following lemma:

Lemma 1 *The manufacturers' profits under different vertical arrangements depend on the degree of product differentation (a). For;*

(i) $0 < a < .7078$
$\Pi_{mix,NET} > \Pi_{NET} > \Pi_{ET,ED} > \Pi_{mix,ET} > \Pi_{ET,NED}$
(ii) $.7078 < a < .9121$
$\Pi_{mix,NET} > \Pi_{ET,ED} > \Pi_{NET} > \Pi_{mix,ET} > \Pi_{ET,NED}$
(iii) $.9121 < a < .9717$
$\Pi_{mix,NET} > \Pi_{ET,ED} > \Pi_{mix,ET} > \Pi_{NET} > \Pi_{ET,NED}$
(iv) $.9717 < a < 1$
$\Pi_{ET,ED} > \Pi_{mix,NET} > \Pi_{NET} > \Pi_{mix,ET} > \Pi_{ET,NED}$

Proof. See appendix

So, it is never profitable for manufacturers to adopt (ET;NED). If a manufacturer opts for ET, it will be better for the manufacturer to choose ED, because choosing ED dampens inter-brand competition, thus enabling the manufacturer to gain more profit.

If the brands are sufficiently differentiated, thus face a weak cross-price effect (inter-brand competition), it will be more profitable for a manufacturer to switch to NET. In ET case, the retailer will be able to extract a higher mark-up price because the retailer is the sole distributor within the geographical region. This may squeeze the manufacturers' profits due to the double mark-up problem. Switching to NET will enable manufacturers to sustain a monopoly power upon retailers, and to avoid the successive mark-up problem.

If the brands are almost homogeneous, a stronger inter-brand competition across retailers and within a retailer itself (if the retailer carries other brands) will occur. This will influence the demand faced by the retailer. Thus, a retailer which carries several brands may experience a brand-switching due to a tougher inter-brand competition. This may reduce the wholesale profit of a manufacturer. To increase profit, the manufacturer may switch to ED, thus relaxing inter-brand competition and avoiding brand-switching within a store. In addition, it will also be better for the manufacturer to restrict intra-brand competition by assigning an exclusive territory right to a retailer. This will enable the retailer to obtain a higher profit on the product, and thus inducing retailer's incentive to distribute the product.

Next, we look at the total surplus under different arrangements. Again, the total surplus depends on the degree of product differentiation (a). Thus, we have the following welfare comparison;

Lemma 2 *The total surplus under different vertical arrangements depend on the degree of product differentation (a). Thus, for;*

(i) $0 < a < .2381$
$TS_{NET} > TS_{mix} > TS_{ET,ED} > TS_{ET,NED}$
(ii) $.2381 < a < .5255$
$TS_{NET} > TS_{ET,ED} > TS_{mix} > TS_{ET,NED}$
(iii) $.5255 < a < 1$
$TS_{NET} > TS_{ET,ED} > TS_{ET,NED} > TS_{mix}$

Proof. See appendix

The most desirable arrangement from the welfare point of view is NET. In this case, the retail competition forces retailers to charge a zero mark-up. This is good news for the consumers since they are now facing a lower retail price, and thus experiencing a higher consumer surplus. In most cases the wholesale profit increases because of the elimination of the double mark-up problem. On the contrary, the retail profit decreases because of intense retail competition. Since the increase in consumer surplus and wholesale profit offset the decrease in retail profit, the net effect on total welfare is positive.

However, if the brands are almost homogeneous, the wholesale profit could possibly decrease as manufacturers are also facing intense competition from other brands, which forces them to charge a lower price. From lemma 1 we know that in this case, manufacturers may restrict intra-brand competition and grant an exclusive dealership to a retailer to relax inter-brand competition, and thus to increase the wholesale profits. If the manufacturers are indeed to switch to this arrangement[5], then we have unfavourable effect on welfare.

3.6 Equilibrium Choice of Vertical Arrangements

In this sub-section, we solve for the first stage of the game. We are interested in finding the pure strategy subgame perfect Nash-Equilibria. The structure of this analysis can be illustrated using table 1. The column and the row indicate respectively the choice of strategies of the first and the second manufacturers. Note that in this paper (ET;ED) and (ET;NED) cannot occur

[5] We still have to solve the first stage of the game to determine which arrangement is the subgame-prefect nash-equilibrium.

	NET	(ET;ED)	(ET;NED)
NET	Π_{NET} Π_{NET}	$\Pi_{mix,NET}$ $\Pi_{mix,ET}$	$\Pi_{mix,NET}$ $\Pi_{mix,ET}$
(ET;ED)	$\Pi_{mix,ET}$ $\Pi_{mix,NET}$	$\Pi_{ET,ED}$ $\Pi_{ET,ED}$	$\Pi_{ET,ED}$ $\Pi_{ET,ED}$
(ET;NED)	$\Pi_{mix,ET}$ $\Pi_{mix,NET}$	$\Pi_{ET,ED}$ $\Pi_{ET,ED}$	$\Pi_{ET,NED}$ $\Pi_{ET,NED}$

Table 1: The First Stage

simultaneously. This is a consequence of the two manufacturers case. Thus, even if a manufacturer initially wants to adopt NED, it may not be able to do so if the second manufacturer prefers to adopt ED. Thus, the first manufacturer is then forced to adopt ED as well. Hence, as we can see from table 1, when the first manufacturer prefers to choose (ET;ED) and the second one prefers to choose (ET;NED), the outcome is the same as when the two manufacturers adopt (ET;ED).

Therefore, we will just denote both cases as NET. The equilibrium outcomes depend on the magnitude of the wholesale profits, which in turn depends on the value of a. The following proposition summarizes the result.

Proposition 1 *In case (i) of Lemma 1, the unique subgame perfect nash-equilibrium is playing NET. In case (ii), the game is a classic prisoner's dilemma and the subgame perfect Nash-equilibria is playing NET. In case (iii), we have a coordination problem. If the first manufacturer plays ET, the second manufacturer plays NET, vice versa. In case (iv), the unique subgame perfect nash-equilibrium is playing (ET;ED).*

Proof. It is easy to see that if case (*i*) prevails, both players have no incentive to deviate. Any deviation only gives a lower profit. In case (*ii*), playing (ET;ED) yields a better outcome for both players than playing NET. However, players cannot credibly commit to play (ET;ED), because one player has an incentive to deviate to NET, thus obtaining a higher profit at the expense of the opponent. In case (*iii*), we have equilibria in mixed cases, in the sense that a manufacturer adopts ET (NET), and another manufacturer adopts NET (ET). In mixed cases both manufacturers would like to play NET in the first place, because playing NET in mixed cases yields a higher profit than playing ET. However, if both manufacturers adopt NET both will get lower payoffs than if one of them adopts ET. We have a coordination problem here concerning who will be the one adopting NET and the one adopting ET. In case (*iv*), it is trivial to see that any deviations from the equilibrium will give lower profits. ■

The results of our analysis show that for brands that are sufficiently differentiated, manufacturers have an incentive to adopt NET which is optimal from the point of view of the society and consumers. If the brands are highly differentiated, the cross price effect will be weak, thus manufacturers enjoy a kind of monopoly power on their product. The profits will be even higher if manufacturers are able to eliminate the successive mark-up. In doing so, manufacturers may want to allow for a more intra-brand competition at the retailer level. The best strategy for the opponent in this case is also playing NET.

In the intermediate case, in which we have a prisoner's dilemma. The equilibrium outcome is not the first best outcome for manufacturers since if both firms can cooperate in choosing (ET;ED) they will be better-off. On the contrary, from the welfare point of view, this outcome is socially desirable, as can be inferred from lemma 2.

At some high interval value of 'a', we have asymmetric result in which a manufacturer prefers to adopt the opposite strategy of his opponent. This outcome is less socially desirable than the outcome of the symmetric result which is obtained when both manufacturers adopt NET.

If the brands are highly homogeneous, both manufacturers have incentive to impose exclusive territory and exclusive dealership restrictions. In case the equilibrium is (ET;ED), we have a situation which is not first-best from the welfare point of view. To obtain the first-best, intra-brand competition should be promoted.

4 Policy Implications

The following proposition explains the welfare implications of manufacturers' choices of vertical arrangements and its policy implications.

Proposition 2 (*i*) *If products are sufficiently differentiated, any policy measures to restrict vertical restraints (exclusive dealing and exclusive territory in our case) are not necessary. In equilibrium, manufacturers prefer to adopt NET, which is optimal from a welfare point of view.* (*ii*) *Such policies become necessary in the case in which products are highly homogeneous. In this case, there might be an incentive for manufacturers to impose exclusive territory and exclusive dealing simulta-*

neously. This arrangement is less socially desirable than if intra-brand competition (non exclusive territory) prevails.

This paper shows that in judging the desirability of vertical restraints, the policy makers need to consider the degree of product differentiation in the market. More specificly, as our analysis has shown, a policy prohibiting ED might not be a sensible policy. The model casts doubts on the desirability of a switch from ED to NED in the presence of intra-brand competition. The more sensible policy is contemplating on the policy promoting intra-brand competition, for instance by prohibiting the exclusive territory restriction. Prohibition of exclusive territory will promote intra-brand competition which is socially desirable. In this case, as our model has shown, it will not really matter whether manufacturers adopt exclusive dealing or not. Strong intra-brand competition will force retailers to charge a zero mark-up, which will make exclusive dealing and non exclusive dealing under intra-brand competition result in the same outcome. It is argued here that focusing on the removal of ED without doing something to promote intra-brand competition may not give much help.

Our results can be used to analyse the case of car distribution system in Europe. Under article 85 of the EEC treaty and subject to certain conditions, exclusive dealing relationship among car manufacturers and their retailers are exempted groupwise from the ban on competition distorting agreements. The group exemption expired on June 30, 1995, and it has been extended since then by the European Commission after resolving a question of whether to grant a new exemption or not and under which conditions.[6] With respect to this case, the paper gives results which are quite different from the arguments usually made in the debate on the proposed regulation for the automobile industry. There, it is frequently argued that the European Commission should promote inter-brand competition for automobiles. Once there is enough inter-brand competition, vertical restraints are not considered to be harmful.[7] On the basis of our model, in choosing between exclusive and non exclusive dealing, intra-brand competition is the important issue.

[6]Note that the regulation for the car industry is just one group exemption. In the coming years other group exemptions will expire and the European Commission will face similar issues.

[7]See for instance The Economist (Sept 24, 1994).

5 Concluding Remarks

In this paper, we analyse the equilibrium choice of vertical restraints chosen by manufacturers in a three-stage Bertrand-Game with product differentiation. In the first stage, we endogenize manufacturers' decision to have a particular form of vertical restraints. In the second stage manufacturers set the wholesale price, and in the third stage retailers set the retail price. We concentrate on two types of vertical restraints, i.e. exclusive dealing and exclusive territory (intra-brand competition).

It turns out that the incentive to choose a particular form of vertical restraints depends on the degree of product differentiation. For a sufficiently high degree of product differentiation (products tend to be heterogeneous), intra-brand competition is preferred by manufacturers, and for a sufficiently low degree manufacturers prefer to choose (ET;ED). From a social welfare point of view, intra-brand competition is the most desirable arrangement.

These results imply that for a market in which products are highly differentiated, any policy measure to restrict vertical restraints such as exclusive dealing and exclusive territory restriction becomes less important. Only for the case of homogeneous products do these policies matter. However, care has to be exerted in devising such policies. Our results show that exclusive dealing per-se is not necessarily harmful, so a policy prohibiting exclusive dealing might not be a sensible one. The more sensible policy is contemplating on the policy promoting intra-brand competition, perhaps by restricting the use of exclusive territory.

APPENDIX

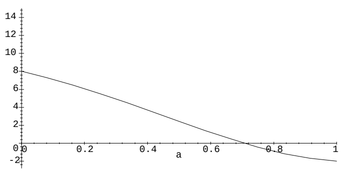
Proof of proposition 2.

Comparison of $\Pi_{(ET;ED)}$ and $\Pi_{(ET;NED)}$

Subtracting equations (3.8) from (3.16) we have $\left((a+2)\frac{a^2-2}{(a-2)(2a^2+a-4)^2}\right) - \left(\frac{1}{2(a-2)^2}\right) = -\frac{1}{2}a\frac{2a^3-3a+4a^2-8}{(a-2)^2(2a^2+a-4)^2}$. As $0 \leqslant a \leqslant 1$, we know that the denominator is positive. Taking the f.o.c. of the numerator w.r.t. a,and equalising to zero, we find that $a = -\frac{2}{3}$ is the extreme point. It can be easily verified that the second order derivative of the numerator is positive, thus we are sure that the numerator is negative. Hence, we know that $\Pi_{(ET;ED)} > \Pi_{(ET;NED)}$. ■

Comparison of $\Pi_{(ET;ED)}$ and Π_{NET}

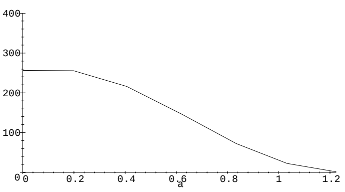
Subtracting equations (3.8) from (3.21) we have $\left((a+2)\frac{a^2-2}{(a-2)(2a^2+a-4)^2}\right) - \left(\frac{1}{(a-2)^2}\right) = -\frac{3a^4-9a^2+8+4a^3-8a}{(a-2)^2(2a^2+a-4)^2}$. The denominator is clearly positive. Putting the numerator, $(3a^4 - 9a^2 + 8 + 4a^3 - 8a)$, into a two dimensional graph, and finding the real roots of it we have; $\{a = .70781\}$, $\{a = 1.316\}$, and,



Hence, there are two values for the numerator; for $1 > a > .70781$ we have $\Pi_{(ET;ED)} > \Pi_{NET}$, and for 0<a<.70781 we have $\Pi_{(ET;ED)} < \Pi_{NET}$. ■

Comparison of $\Pi_{(ET;ED)}$ and $\Pi_{(mix;ET)}$

Subtracting equation (3.8) from (3.36) we have $\left((a+2)\frac{a^2-2}{(a-2)(2a^2+a-4)^2}\right) - \left(\frac{1}{2}\frac{\left(a^2-2a-4\right)^2}{(5a^2-8)^2}\right) = -\frac{1}{2}a\frac{-464a^2+296a^4-73a^6+256+96a-160a^3+94a^5-20a^7+4a^8}{(a-2)(2a^2+a-4)^2(-8+5a^2)^2}$. The denominator is negative. Again putting the numerator $(-464a^2 + 296a^4 - 73a^6 + 256 + 96a - 160a^3 + 94a^5 - 20a^7 + 4a^8)$ into a two dimensional graph we have,

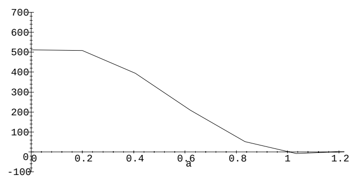


The numerator is negative, hence, we have $\Pi_{(ET;ED)} > \Pi_{(mix;ET)}$. ■

Comparison of $\Pi_{(ET;ED)}$ *and* $\Pi_{(mix;NET)}$

Subtracting equations (3.8) from (3.37) we have $\left((a+2)\frac{a^2-2}{(a-2)(2a^2+a-4)^2}\right) - \left(\frac{2a^2+48a+32-9a^4-24a^3}{(5a^2-8)^2}\right) =$

$\frac{1}{2}\frac{-704a^3+666a^5-261a^7+256a-1280a^2+1148a^4-438a^6+512+60a^8+36a^9}{(a-2)(2a^2+a-4)^2(-8+5a^2)^2}$. The denominator is negative. Finding the real roots of the numerator $(-704a^3 + 666a^5 - 261a^7 + 256a - 1280a^2 + 1148a^4 - 438a^6 + 512 + 60a^8 + 36a^9)$, we find $\{a = -1.9014\}$, $\{a = -1.4142\}, \{a = -1.293\}, \{a = .97165\}, \{a = 1.2212\}, \{a = 1.4142\}$, $\{a = 1.6938\}$. Next, putting the numerator into two dimensional graph we have,



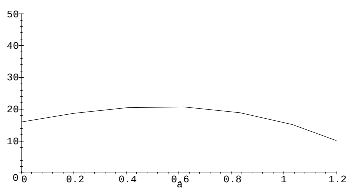
Thus, there are two values for the numerator; for $0 < a < .97165$ we have $\Pi_{ET,ED} < \Pi_{mix,NET}$, and for $.97165 < a < 1$ we have $\Pi_{(ET;ED)} > \Pi_{(mix;NET)}$. ■

Comparison of $\Pi_{(ET;NED)}$ *and* Π_{NET}

Subtracting equations (3.16) from (3.21) we have $\left(\frac{1}{2(a-2)^2}\right) - \left(\frac{1}{(a-2)^2}\right) = -\frac{1}{2(a-2)^2}$. We have a positive sign for the denominator. Hence, it is obvious that $\Pi_{(ET;NED)} < \Pi_{NET}$. ■

Comparison of $\Pi_{(ET;NED)}$ *and* $\Pi_{(mix;ET)}$

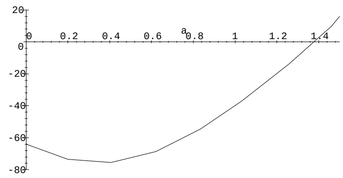
Subtracting equations (3.16) from (3.36) we have $\left(\frac{1}{2(a-2)^2}\right) - \left(\frac{1}{2}\frac{\left(a^2-2a-4\right)^2}{(5a^2-8)^2}\right)$ $= -\frac{1}{2}a^2\frac{16-9a^2+16a+a^4-8a^3}{(a-2)^2(-8+5a^2)^2}$. It is obvious that the denominator is positive. Drawing the two dimensional graph of the numerator we have,



Hence, the numerator is positive, and we know that $\Pi_{(ET;NED)} < \Pi_{(mix;ET)}$. ■

Comparison of $\Pi_{(ET;NED)}$ *and* $\Pi_{(mix;NET)}$

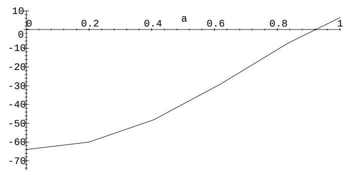
Subtracting equations (3.16) from (3.37) we have $\left(\frac{1}{2(a-2)^2}\right)$-$\left(\frac{2a^2+48a+32-9a^4-24a^3}{(5a^2-8)^2}\right)$ $= \frac{1}{2}\frac{-64+72a^2-37a^4-64a+56a^3-12a^5+9a^6}{(a-2)^2(-8+5a^2)^2}$. The denominator is positive. Drawing the two dimensional graph of the numerator we have,



Hence, the numerator is positive, and we know that $\Pi_{(ET;NED)} < \Pi_{(mix;NET)}$. ■

Comparison of Π_{NET} and $\Pi_{(mix;ET)}$

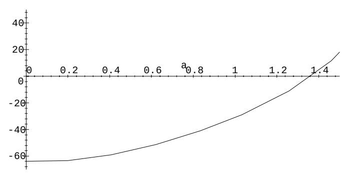
Subtracting equations (3.16) from (3.36) we have $\left(\frac{1}{(a-2)^2}\right) - \left(\frac{1}{2}\frac{\left(a^2-2a-4\right)^2}{(5a^2-8)^2}\right) =$ $-\frac{1}{2}\frac{-64+96a^2-34a^4+16a^3+a^6-8a^5}{(a-2)^2(-8+5a^2)^2}$. We have a positive sign for the denominator. Taking the real roots of the numerator we obtain $\{a = -2.569\}, \{a = -1.4142\}, \{a = -1.2519\}, \{a = .9121\}, \{a = 1.4142\}, \{a = 10.909\}$. Note that $0 < a < 1$. L ooking through the graph of the numerator we have,



It is easy to see that for 0<a<.9121 we have $\Pi_{NET} > \Pi_{(mix;ET)}$, but for .9121<a<1 we have $\Pi_{NET} < \Pi_{(mix;ET)}$. ■

Comparison of Π_{NET} and $\Pi_{(mix;NET)}$

Subtracting equations (3.16) from (3.37) we have $\left(\frac{1}{(a-2)^2}\right)-\left(\frac{2a^2+48a+32-9a^4-24a^3}{(5a^2-8)^2}\right)$ $= \frac{1}{2}a\frac{-8a-12a^3-64+56a^2-12a^4+9a^5}{(a-2)^2(-8+5a^2)^2}$. The denominator is positive. Plotting the numerator $(-8a - 12a^3 - 64 + 56a^2 - 12a^4 + 9a^5)$ we have,

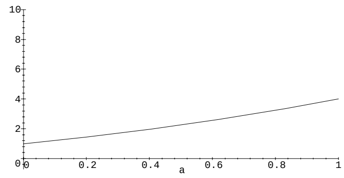


Hence, $\Pi_{NET} < \Pi_{(mix,NET)}$. ■

Comparison of $\Pi_{(mix;ET)}$ *and* $\Pi_{(mix;NET)}$

Subtracting equations (3.36) from (3.37) we have $\left(\frac{1}{2}\frac{\left(a^2-2a-4\right)^2}{\left(5a^2-8\right)^2}\right)-\left(\frac{2a^2+48a+32-9a^4-24a^3}{\left(5a^2-8\right)^2}\right)=\frac{a^2+2a+1}{-8+5a^2}$. The denominator is negative, and from the plot of the numerator,

1



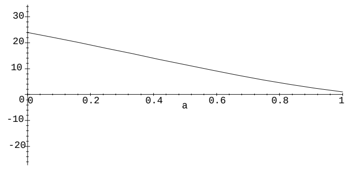
Thus, we know that $\Pi_{(mix;ET)} < \Pi_{(mix;NET)}$. ■

Summarising all the above comparative analysis we can proof that (i) For $0 < a < .70781; \Pi_{(mix,NET)} > \Pi_{NET} > \Pi_{(ET,ED)} > \Pi_{(mix,ET)} > \Pi_{(ET,NED)}$ (ii) For $.70781 < a < .9121; \Pi_{(mix,NET)} > \Pi_{(ET,ED)} > \Pi_{(NET)} > \Pi_{(mix,ET)} > \Pi_{(ET,NED)}$ (iii) For $.9121 < a < .9717; \Pi_{(mix,NET)} > \Pi_{(ET,ED)} > \Pi_{(mix,ET)} > \Pi_{NET} > \Pi_{(ET,NED)}$ (iv) For $.9717 < a < 1; \Pi_{(ET,ED)} > \Pi_{(mix,NET)} > \Pi_{(mix,ET)} > \Pi_{NET} > \Pi_{(ET,NED)}$ ■

Proof of proposition 3

Comparison of $TS_{(ET;ED)}$ and $TS_{(ET;NED)}$

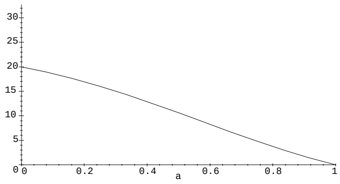
Subtracting equations (3.10) from (3.17) we have $\left((a^2-2)\frac{-5a^2+14-12a+4a^3}{(-1+a)(a-2)^2(2a^2+a-4)^2}\right)-\left(\frac{4a-7}{4(a-1)(a-2)^2}\right)=-\frac{1}{4}a\frac{8a^3-23a-8a^2+24}{(-1+a)(a-2)^2(2a^2+a-4)^2}$. The denominator is negative. Plotting the numerator $(8a^3-23a-8a^2+24)$ we have,



From the graphical analysis we are sure that the numerator is positive, hence we know that $\mathrm{TS}_{(ET;ED)} > TS_{(ET;NED)}$. ■

Comparison of $TS_{(ET;ED)}$ and TS_{NET}

Subtracting equations (3.10) from (3.22) we have $\left((a^2-2)\,\frac{-5a^2+14-12a+4a^3}{(-1+a)(a-2)^2(2a^2+a-4)^2}\right)$ -$\left(\frac{-3+2a}{(-1+a)(a-2)^2}\right)=-\frac{4a^4+5a^3-17a^2-12a+20}{(2a^2+a-4)^2(a-2)^2}$. The denominator is positive. Again, plotting the numerator $(4a^4+5a^3-17a^2-12a+20)$ we have,

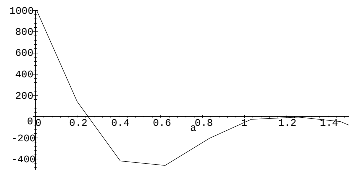


It is obvious that the numerator is positive, hence we know that TS$_{(ET;ED)}$ $<$ TS_{NET}. ■

Comparison of $TS_{(ET;ED)}$ and TS_{mix}

Subtracting equations (3.10) from (3.38) we have $\left((a^2-2)\,\frac{-5a^2+14-12a+4a^3}{(-1+a)(a-2)^2(2a^2+a-4)^2}\right)-$ $\left(\frac{124a^3+300a^2-240-96a-85a^4-33a^5}{8(a-1)(-8+5a^2)^2}\right)=$

$\frac{1}{8}\frac{352a^4-312a^6+257a^8-1088a^2+10432a^3-9632a^5+4668a^7-1211a^9+1024-4608a-56a^{10}+132a^{11}}{(-1+a)(a-2)^2(2a^2+a-4)^2(-8+5a^2)^2}$. The denominator is negative. Taking the real roots of the numerator we find $\{a=-1.7086\}$, $\{a=.23806\}$, $\{a=1.1165\}$, $\{a=1.2217\}$, $\{a=1.8285\}$. Next, plotting the numerator we find,



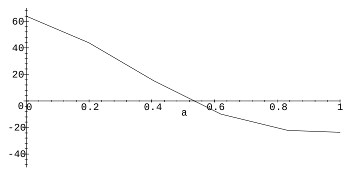
There are two values for the numerator, and the cut-off point is.2381. Hence, for .2381 $< a <$ 1we have TS$_{(ET;ED)}$ $> TS_{mix}$, while for $0 < a < .2381$ we have TS$_{(ET;ED)}$ $< TS_{mix}$. ■

Comparison of $TS_{(ET;NED)}$ and TS_{NET}

Subtracting equations (3.17) from (3.22) we have $\left(\frac{4a-7}{4(a-1)(a-2)^2}\right)-\left(\frac{-3+2a}{(-1+a)(a-2)^2}\right)=$ $-\frac{1}{4}\frac{4a-5}{(a-1)(a-2)^2}$.We know that the denominator is negative, and the numerator $(4a-5)$ is positive, therefore TS$_{(ET;NED)}$ $< TS_{NET}$. ■

Comparison of $TS_{(ET;NED)}$ and TS_{mix}

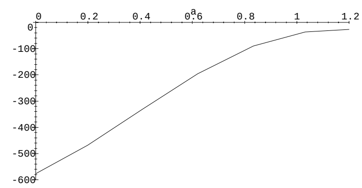
Subtracting equations (3.17) from (3.38) we have $\left(\frac{4a-7}{4(a-1)(a-2)^2}\right)-$ $\left(\frac{124a^3+300a^2-240-96a-85a^4-33a^5}{8(a-1)(-8+5a^2)^2}\right)=\frac{1}{8}\frac{-64a+160a^3-132a^5+64-224a^2+186a^4-47a^6+33a^7}{(a-1)(a-2)^2(-8+5a^2)^2}$.
Plotting the numerator we have,



There are two values for the numerator, and the cut-off point is.5255. Hence, for .2381 $< a <$ 1we have TS$_{(ET;NED)}$ $> TS_{mix}$, while for $0 < a < .5255$ we have $TS_{(ET;NED)<}$ TS_{mix}. ■

Comparison of TS_{NET} and TS_{mix}

Subtracting (3.22) from (3.38) we have $\left(\frac{-3+2a}{(-1+a)(a-2)^2}\right)-\left(\frac{124a^3+300a^2-240-96a-85a^4-33a^5}{8(a-1)(-8+5a^2)^2}\right)=\frac{1}{8}\frac{-576+576a^2-64a^4+448a-480a^3+68a^5-47a^6+33a^7}{(-1+a)(a-2)^2(-8+5a^2)^2}$. The denominator is negative. Plotting the numerator we have,



The numerator is negative, hence TS$_{NET}$ $>TS_{mix}$. ■

Summarising the above results we find that for $0 < a < .23181$ we have $TS_{NET} > TS_{mix} > TS_{ET,ED} > TS_{ET,NED}$,for $.23181 < a < .5255$ we have $TS_{NET} > TS_{ET,ED} > TS_{mix} > TS_{ET,NED}$. And for $.5255 < a < 1$ we have $TS_{NET} > TS_{ET,ED} > TS_{ET,NED} > TS_{mix}$. ■

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